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WINDBREAKS

in Conservation Farming

Miscellaneous Publication No. 759

U. S. DEPARTMENT OF AGRICULTURE
Soil Conservation Service

COUPLED with other conservation practices, tree windbreaks—field and farmstead—are proving to be effective soil conservers in many parts of the country. And they have other appealing values and uses.

Field windbreaks are most needed where soil blowing may be a problem, such as in the sandy and muck soils in the Great Lakes region; on sandy soils along the Gulf and Atlantic seaboards; in the irrigated valleys of the Pacific southwest and the Colorado and Columbia River basins; and in parts of the vast Great Plains. You should consider farmstead windbreaks almost anywhere in the country where uncomfortable winter and summer winds occur.

This bulletin points out many values and uses of windbreaks and tells how they can be fitted into conservation farming.

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78,304

Front cover—A system of patterned windbreaks on a farm near the Texas-Oklahoma State line. Each field is blocked in with tree barriers to protect soils and crops.

Washington, D. C. August 1958

Windbreaks in Conservation Farming

By Arthur E. Ferber, *woodland conservationist, Soil Conservation Service*

TREES are mother nature's outdoor air conditioners. If hot searing summer winds, raw wintry blasts, or soil blowing are a problem on your farm, tree windbreaks can help you provided trees can be successfully grown in your community. Well-planned windbreaks for your fields and crops, buildings, livestock, orchard and garden, and wildlife will benefit you and also increase the value of your farm.

We all want greater comfort for our homes and protection against biting frigid storms and soil-blowing gales. Where natural protection is lacking tree windbreaks give this welcome shelter. Add to this the beauty and homelike setting which trees bring to a home and community. The returns in comfort and economy far outweigh the cost. Thousands of farmers, ranchers, and orchardists are finding windbreaks a good investment—good for the home, for crops, and for fields.

Conservation Uses of Windbreaks

The main purpose for growing tree windbreaks on your farm or ranch is to protect people, soil, crops, and livestock against wind. Since you plant them on cropland, their use must be woven in with your farming activities and become a part of your farm—to be tended and cared for like other crops.

Although windbreaks have been used more in the North and West than in the South, farmers and ranchers have found them useful in almost every State in the country—even in the Deep South—wherever wind is damaging or discomforting.

Field windbreaks can be grown successfully everywhere that precipitation and soils will support good tree growth. They are not needed everywhere. But where you need to control wind or drifting snow on your farm or ranch, tree windbreaks will be useful. As a soil and moisture conservation measure, tree windbreaks are not cure-alls. They merely supplement and aid other conservation measures.

Windbreak barriers help control soil blowing in clean cultivated fields and cut down the drying effects of wind on soil and plants in areas where they can be grown successfully. In the North trees may also trap snow in winter that crops can use in spring and their branches furnish homes for insect-eating birds. The water from melting snow helps build up ground-water supplies. Upland game

A half-mile long windbreak of evergreens (conifers), hardwood (deciduous) trees, and shrubs protects this Nebraska farmstead and fields. It also provides shelter and food for wildlife. Many thousands of fine windbreaks like this have been planted in the Plains.

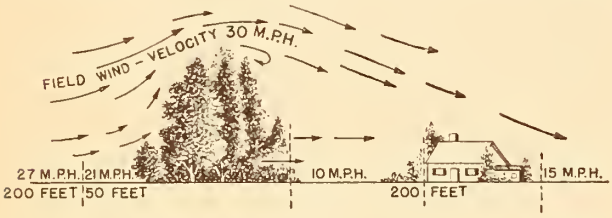
birds and other wildlife use windbreaks for cover, food, nesting, and travel lanes.

Planted around buildings and yards, windbreaks protect people, livestock, and the farmyard from high winds, dust, and drifting snow. These farmstead windbreaks also provide food and shelter for songbirds, game, and other beneficial wildlife, and protect bees and other pollinating insects.

To reduce soil blowing

A good vegetative cover such as stubble or stalks will protect cropland from blowing better than any other practice. But some kinds of crops produce little stubble or residue. And in some seasons there may be crop failures when scarcely no residue is produced. On situations like this, tree windbreaks will help to reduce soil blowing.

Field windbreaks act as barriers to slow down winds, making soil less apt to blow and drift. Wind-current reduction is more apparent on the lee



Windbreaks reduce wind currents: Part of the air current is diverted over the top of the trees and part of it filters through the trees. Farmstead, livestock, and wildlife windbreaks should be relatively dense and wide to give maximum protection close to the trees. Field, orchard, and garden-type windbreaks need not be so wide and dense.

side of windbreaks, but some decrease will also show up on the windward side—where the wind strikes first.

Crop yields in some areas have been lowered for a long time as a result of severe soil blowing. On many soils there are 10 to 20 times as much humus and phosphate in the soil that blows from a field as in the heavier particles that stay on the field. By reducing the force of the wind, you keep this valuable soil on your farm.

Most soils will not blow until wind currents move faster than 15 to 20 miles an hour at the ground line. Experiments show that a good windbreak cuts down a 30-mile-per-hour wind to less than half. And the wind is slowed down as far out as 15 to 20 times the height of the trees—sometimes more.

The force of wind in causing soil blowing varies as the square of its velocity. Thus a 40-mile-per-hour wind has about 4 times as much power to pick up soil as a 20-mile-per-hour wind. Soil blowing can be checked to a large degree by only a small reduction in wind velocity at the ground surface.

NJ—40,403

Privet-hedge windbreaks on this sandy New Jersey farm help control soil blowing and protect crops. This farmer also uses a rye cover crop with his windbreak system.

When a field begins to blow, the damage may spread. Soil drifting can also damage crops in adjoining fields. And insects and weed seeds may be carried many miles.

Large open fields where winds can get a good sweep are more apt to blow than small ones. Here you may need a series of windbreaks planted in strips at right angles to the damaging winds. Use other conservation practices such as stripcropping, stubble-mulch cover, and good crop rotations with windbreaks to hold your soil-blowing problem to a minimum.

Windbreaks are also useful in irrigated sections

WYO—513

A 6-year-old field windbreak of trees and shrubs in an irrigated valley in Wyoming. These trees do not use much land and help to hold the soil in place. Livestock are sheltered on the lee side during winter months.

where soil blowing is a problem. In sandy areas drifting soil may fill irrigation and drainage ditches.

Windbreaks make other conservation practices more effective. Where trees do fairly well and where soil blowing is a problem, field windbreaks in most cases will more than pay for themselves, even on high-priced land.

To protect crops

The benefits of wind protection on crop yields have not been thoroughly tested by experiment stations in this country. Specific results are hard to measure. And they vary from year to year depending on the weather and kinds of crops grown.

In many sandy-land areas, newly seeded crops may blow out several times in one dry season. Winds often shred the leaves of young plants, and sand blasting and abrasion cause serious damage. Reseeding costs cut down your profits. Early planted fields not damaged by blowing usually reach maturity with higher yields since they take advantage of the best weather and moisture conditions.

Later in the season your crop yields may be lowered from blasting or firing by hot southerly winds. High winds cause lodging and blowdown and may scatter windrowed crops. Cornstalks weakened by borers are especially susceptible to high winds. Windbreaks help to slow down these winds and reduce losses.

In the northern and central States the added moisture from snowdrifts on the lee side of windbreaks usually helps to increase crop yields. Fertilizers may be added to take advantage of this additional moisture. Furthermore, alfalfa can be grown on soil receiving such extra moisture in areas normally too dry for a successful crop. Also the snow cover kept on the ground protects wheat, grass, and legumes from winter injury.

Landowners have made numerous observations. In South Dakota, 331 farmers were asked by personal interview about their experiences with field windbreaks during the 1952, 1953, and 1954 seasons. Six out of 7—or 274 of these farmers—noted increased crop yields in 1 or more years of the 3-year period. The farmers believed the increases were due to their windbreaks. They estimated an increase of from 5 to 9 bushels of corn per acre on the parts of the fields protected by windbreaks. This was in a strip 10 to 15 rods wide parallel to the trees. And similar increases were noted in other crops.

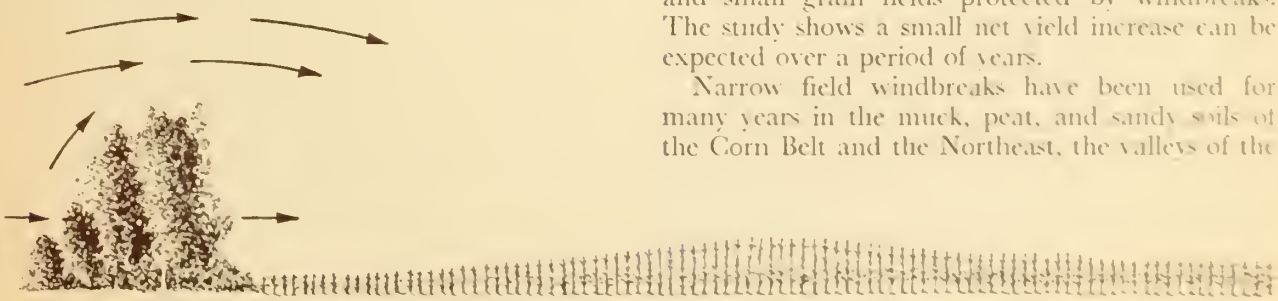
CAL—6676

Eucalyptus tree windbreak protects sugar-beet crop in Salinas Valley, California.

Agricultural scientists at a Canadian experiment station kept detailed records on wheatfields over a 5-year period, 1950–54. Fields protected by windbreaks showed a net increase of 0.7 of a bushel per acre as compared with those not protected. This takes into account the land used by the trees. The greatest increase occurred during the driest years. And soil blowing was held to a minimum.

The U. S. Forest Service has gathered crop-yield information in the Great Plains on over 200 corn and small grain fields protected by windbreaks. The study shows a small net yield increase can be expected over a period of years.

Narrow field windbreaks have been used for many years in the muck, peat, and sandy soils of the Corn Belt and the Northeast, the valleys of the



A windbreak and grain crop: Often crop yields are lowest next to the trees. A common mistake is to observe only this area—the greatest gains are out a few more rods.

MICH—60,918

This Michigan farmer uses 1-row willow windbreaks to protect his fields and onion crops.

ND—568

This field windbreak of adapted trees and shrubs in the northern Plains protects the fields and crops, catches snow, and more than pays for the land it uses. It also provides cover and food for game and insect-eating birds.

NY—932

A 6-row windbreak protects the fields and crops on this New York farm and also provides wildlife cover.

Pacific Coast States, the Southwest, and other parts of the country. Farmers have found them one of the best ways to control soil blowing and they are valued for crop protection.

Windbreaks make sprinkler irrigation easier by protecting against shifting winds, and pipelines do not have to be reset so often. This gives a more uniform distribution of water. Windbreaks also make surface irrigation more effective.

With good windbreaks many cotton farmers in the sandy lands of Texas and Oklahoma get cleaner and whiter cotton and less boll shedding. Their cotton grades higher and brings a better price. The lint is more nearly free of sand and cotton picking need not be delayed because of high winds.

Some farmers say that windbreaks used for crop and field protection have disadvantages. Some object to windbreaks because they occupy cropland; they sap moisture from the crops planted next to them; weeds and dirt may drift into them; they take time to grow and require care to keep them growing well; and where snowdrifting is heavy next to windbreaks, they may delay spring work.

On the other hand, many landowners say the advantages outweigh the disadvantages. It is true that windbreaks will not increase crop yields every year. During some years there may be no difference—in others, yields may decrease a trifle. But in the long run field windbreaks often are moneymakers. The saving of one season's crop could pay for the cost of the windbreak.

Many farmers say they would rather have field windbreaks and the added protection they give than to farm the whole acreage without trees. Windbreaks take some of the risk out of farming and increase the opportunities in some cases to farm more intensively and grow crops that yield a higher income.

To protect farmsteads and livestock

Tree windbreaks can protect your farmstead and livestock more cheaply than any other method. A lot of your family's time is spent in the house and around the yard. A good tree windbreak protects the farmstead from soil blowing, freezing winds, snowdrifts, cold driving rain or sleet, and dusty spring gales. In most parts of the country cold winds cause more discomfort to man and animals than any other climatic factor.

Experiments show that windbreaks can reduce your home-fuel costs 15 percent, or more. Your home will be less drafty and more comfortable. And you will not have as much dust to clean up and worry about.

Where winters are long and drifting snow and blizzards are common, a good windbreak keeps the

This North Dakota farmstead is well protected from wind and drifting snow. Note how the shrub row traps snow. A fruit-bearing shrub row also provides fruit for the table. Ash and elm are reproducing naturally in the windbreak.

farmyard, feedlots, and driveways fairly free of snow in ordinary winters. This in itself is worth the effort of growing a tree windbreak.

Many ranchers are planting windbreaks in range country to protect their cattle and sheep from blizzards and cold driving rains. They find that livestock winter well behind the shelter of windbreaks and come through the winter in better condition. Not only do they need less feed, but their gains are higher. And calving and lambing are less risky behind a windbreak shelter. Dairy farmers find that milk cows are more comfortable in the winter in the lee of a good windbreak and produce more milk on less feed.

Results at the Montana Experiment Station, Havre, Mont., show that a herd of cattle protected by windbreaks gained 35 pounds more each during a mild winter and lost 10½ pounds less during a severe winter than an unprotected herd.

Here, heifers take shelter behind a windbreak during a late snowstorm. They gain more with less feed.

As living snow fences

In snow country, properly located living fences of trees and shrubs parallel to your driveway or to highways helps to hold the snow on the fields and off the roads. For this reason county commissioners and highway departments encourage the planting of trees for snow fences.

The snow fence may also protect adjoining fields and crops and may be a part of your field-wind-

Windbreak traps snow on this eastern Washington hilltop. The snow melts slowly, distributing the moisture over a longer period. This added moisture helps the trees in the windbreak.

NEB—1839

This 50-year-old pine windbreak in range country provides shelter to livestock against cold rains and winter storms.

WN—90,172

This windbreak provides cover and food for pheasants and other beneficial wildlife.

break pattern. In some areas, such as the Red River Valley of North Dakota and Minnesota, living snow fences keep snow and drifting soil out of cropland drainage ditches. This greatly reduces the cost of maintaining these ditches. Some farmers in the Palouse areas of the Pacific Northwest also use living snow fences to trap snow on top of the ridges and distribute it more evenly. Otherwise it drifts onto the leeward steep slopes and when the snow melts it can cause serious soil erosion.

For wildlife habitats

The trees and shrubs used for windbreaks make valuable cover and nesting areas for upland game and songbirds. They make homes close to cropland for insect-eating birds.

In Texas a half-mile field windbreak examined by biologists had 25 occupied bird nests and was sheltering a covey of quail. The biologists estimated that this bird population would destroy about 260 pounds of insects during the year. Pheasants, grouse, quail, partridge, and doves use windbreaks for cover, food, and nesting.

Winter is a critical period for nonmigratory birds and any protective shelter adds to their chances for survival and increase. Windbreaks protect game birds against cold, driving rains, and blizzards. When all other food is blanketed with snow, tree and shrub seeds and fruits provide welcome food.

To be of greatest value to wildlife, a windbreak should include at least one or more rows of dense,

ND—570

This young living snow fence in North Dakota will help to keep roads open during the winter. The grass meadow between the trees and the road produces high yields of hay because of the extra moisture from the snow. These plantings also protect nearby fields and furnish food for wildlife. Note the space left between the trees and the road.

KANS-1641 (INSERT MONT-84

Ten-row Kansas windbreak of Russian-olive, redcedar, ponderosa pine, bur oak, and other shrubs and trees. Closeup inset of Russian-olive shows valuable fruit for wildlife food.

low-growing shrubs or coniferous evergreens, or both. Where blizzards are common, the windbreak must be wide enough and the species arranged to prevent complete filling with snow.

Certain kinds of shrubs and trees are better than others for wildlife. Low-branching evergreens are excellent. Other good species include Autumn-olive, Russian-olive, Aromatic sumac or skunkbush, buffaloberry, wild plum, honeysuckle, hawthorn, privet, chokecherry, and, in parts of the country where it is hardy, multiflora rose. There are many others which may be hardy and useful in your area. Choose only those kinds which are best adapted to your climate and soil.

State game department officials, Soil Conservation Service technicians, and others are available to help you plan your windbreak to make it better for wildlife.

In orchards and gardens

Orchards need shelter against high winds especially during pollination and again when the fruit is ripening. Fruit is often blown off the trees in unprotected orchards—or it is bruised and scarred by the tree limbs. Citrus fruits are easily damaged. The cull percentage is often high. Hot

Windbreak of Casuarina (Australian pine) about 60 feet high shelters this Florida orchard.

CAL—3917

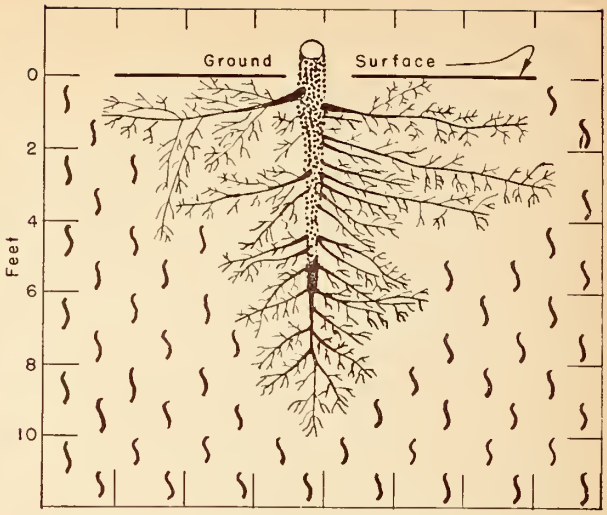
California citrus growers use Eucalyptus tree windbreaks to protect their orchards. Yields are higher and fruit quality is improved.

KANS—1763

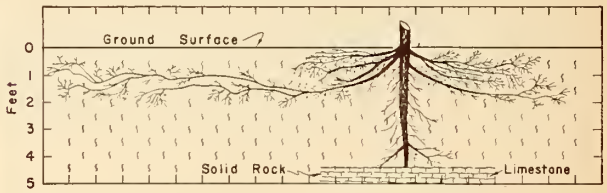
A redcedar and elm windbreak protects this Kansas garden on three sides. Vegetables, flowers, and lawns grow better with shelter from wind.

winds dry up the leaves and fruit but windbreaks help to reduce these losses. Experiment station workers observe that protected orchards produce greater yields and higher quality fruit. And workers at the Northern Great Plains Field Station, Mandan, N. Dak., say it is useless to consider growing fruit on the Plains without windbreak protection. Furthermore, H. E. Wahlberg of Orange County, Calif., reports data that show a net return of $445.48 per acre from 20 citrus orchards having windbreak protection, whereas the return on 20 unprotected orchards averaged only $271.34 per acre.

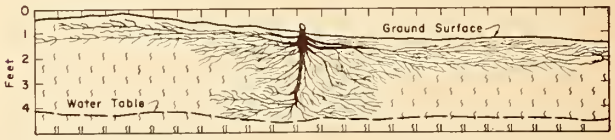
You can spray, dust, and prune the fruit trees easier behind a good windbreak. Honeybees and other pollinating insects are more effective when sheltered against winds. Irrigation evaporation losses are reduced and clean-cultivated orchards are



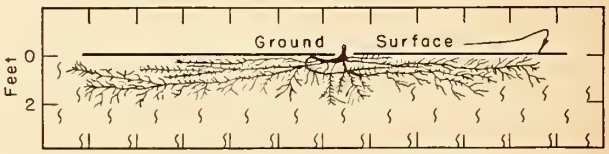
A good loam soil allows moisture penetration and deep, uniform distribution of tree roots.



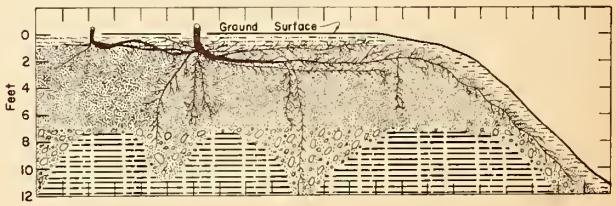
These tree roots could not grow any deeper because of the solid rock.



A high water table prevents deep root penetration. These roots stopped at 4 feet. Tree roots must have air to grow.



The claypan soil restricted the roots of this tree to 2 feet in depth.



Tree roots follow moist sand and gravel pockets.

79,479

The uneven skyline of this Oklahoma windbreak reflects the soil depths in which the trees grow. The permeable soil depths range from 2 feet in the stretches of shorter trees to 5 feet under the taller ones.

protected from soil blowing. In the North, properly located windbreaks trap snow, adding more moisture for fruit production.

The vegetable garden, lawns, shrubbery, and flowers around the farmstead also benefit from properly designed windbreaks. In snow country, many farmers plant their gardens and berry fruits between the windbreak and the buildings to get the advantage of additional moisture from snowdrifts.

Field Windbreaks

Field windbreaks are recommended only where the soil and slope are suitable for cultivation. Successful field-windbreak plantings in the North need a minimum of 14 inches of rainfall plus additional moisture from snowdrifts. However, in some areas with favorable soils, they may be grown with less moisture. They need more rainfall farther South—in Kansas, Oklahoma, and Texas. Here it is hotter and there is more evaporation, a longer growing season, and little moisture provided by snowdrifts. Successful field windbreaks in these southern areas need a minimum of 22 inches of rainfall and require favorable soils. These soils must have a permeability to a depth of at least 6 feet unless extra water can be diverted to the site or there is a high water table.

Where moisture is limited, dense, fine-textured, shallow, or saline-alkali soils are not satisfactory for good tree growth. Neither are coarse, sandy soils that have no moisture-holding layer beneath. Good success may be expected with trees on clay-loam soils that are open, permeable, and well drained. The depth of porous soil strongly affects tree growth and vigor. Most tree roots are in the first 3 to 4 feet of soil, but more space for moisture reserve is especially desirable. Land with a high water table is excellent provided the water is not salty and not too close to the surface. Tree roots need air as well as water.

Where it is arid or where soils are shallow or otherwise not favorable for moisture storage, use only the most drought-hardy kinds of trees and shrubs for field windbreaks. Under these conditions there is little chance to build up a moisture reserve. Windbreaks usually must live on each year's annual

A 1-row evergreen windbreak in Oregon. In areas formerly in forests, windbreaks can be easily grown.

MICH—60,611

This 2-row pine windbreak in Michigan traps snow. Note drifts on both sides of the windbreak. It is about twice as deep on the leeward side as on the windward side. Crops will benefit from the added moisture.

ND—566

A combination living snow fence and field windbreak in North Dakota. Grass planted between windbreak and highway stabilizes the road ditch and furnishes hay for feed.

rainfall and snowmelt unless water is diverted to them from adjacent fields or roadways.

Where rainfall is adequate, as in the Corn Belt or in the Northeast and Southeast, growing field windbreaks is usually not much of a problem. If the soil will grow grain crops in these areas, it will successfully grow adapted trees. Likewise, in the irrigated valleys of the Far West and the intermountain areas good windbreaks usually can be successfully grown. Limiting factors here may be overwatering, poor subsurface drainage, or saline-alkali soils.

Where to place them

Field windbreaks should be laid out to protect your fields and crops against prevailing damaging winds. Usually, they consist of strips of one or more rows of trees placed along the windward side of a field with additional parallel strips through the field. The distance between these strips may range from 10 to 20 times the height of the trees when they are mature.

In some localities, damaging winds come from several directions. Then isolated one-direction windbreaks are of small value. A pattern of windbreaks forming squares or two-direction combinations rather than parallel strips is needed to give protection regardless of wind direction.

Windbreaks reduce wind currents to a practical degree for a distance of about 20 times the height of the trees. Thus a windbreak 30 feet high gives protection to a strip about 600 feet wide. If you know about how tall your trees will grow, you can tell how far apart to place the windbreaks.

The protection you can expect from the trees spaced at this distance will usually be adequate for soil protection under most conditions—especially with other conservation practices. If your fields are quick to blow, place the windbreak strips closer together. If the winds blow uphill, the strips need to be closer together than if they blow downhill.

Your field windbreaks should follow contour lines if your fields are laid out on the contour. Terrace and irrigation systems and contour lines should be laid out before you plant the windbreaks. It may not always be best to plant the entire length of the contoured field, since the direction of the windbreak strip should be generally at right angles to the damaging winds.

A few windbreaks in the right place may keep your irrigation and drainage ditches from filling up with blown soil. But some kinds of trees and shrubs planted too close to main irrigation or drainage ditches may clog the channel with spreading roots. Many species will not do this.

ND—569

An end view of a good windbreak. Note the dense shrubs on the north windward side, followed by two evergreen rows. The medium tall and tall trees are in the center and to the leeward. The last leeward row is a dense, low-branching tree. This provides excellent density from the ground to the top of the windbreak. This wide type is best for farmstead windbreaks. Field windbreaks usually need not be so wide.

NEB-1841; NEB-1842

(Left) A sandy-land Nebraska farm protected by windbreaks and good stubble. (Right) The same farm 8 years later, showing poor farming practices. Even good windbreaks cannot do the whole job alone on erosive sandy soils. Stripcropping and stubble mulching are also needed. Another windbreak planted to the left of the one shown here would also help.

If you live in the North where roads need protection from snowdrifting, consider planting a windbreak next to the road to serve as a living snow fence. Leave at least 100 feet or more between the trees and the road so that snow will not drift across the road. You need this much space whether the trees are north, south, east, or west of the road. Also trees too close to roads may shade the roadbed and cause icy conditions. The area between the windbreak and the road can be planted to crops or grasses that benefit most from the additional moisture from the snowdrifts.

Windbreaks planted next to highways should be laid out to avoid blind corners which are a safety hazard. Also consider telephone and electric lines when you are deciding where to locate your plantings.

It is best to work out your field-windbreak system as a long-range part of your conservation plan and field layout. You will need other conservation practices like stripcropping, stubble mulching, a good cropping system, and measures to improve the structure and tilth of the soil. It is not practical to rely on trees alone to keep the soil from blowing on your farm. They do, however, give you added protection and insurance during the seasons or the years when fields are bare.

It will pay you to get the SCS technician in your local soil conservation district or someone who understands conservation problems to help you plan your field windbreaks. After you get all the facts about your soil and the protection you need, you will be in better position to decide how many field windbreaks are needed and where they should be located. All other conservation practices and field and crop problems can be considered at the same time. This way your windbreak system will fit in most effectively with your farming operations.

What kind of trees and shrubs to use

Several types of evergreen and broadleaf trees are suitable for field windbreaks. There are tall, medium tall, or dense low-growing varieties which can be used together or in combination with shrubs. A good barrier against the wind is uniformly dense from the ground line to the tops of the tallest trees.

But be sure to plant the species that will grow best in your soil and that have proved hardy in your community. Soil types often vary within the windbreak. For example, in a ½-mile planting you may have a wet or alkali area, a stony knoll, or some other less favorable condition. In these areas use species that will grow best under these unfavorable conditions. Failure to do this may result in gaps or holes in the tree barrier. Aim to use those species that will give you as much height and density in the windbreak as your soil and the available moisture will support when the trees are full grown.

Coniferous evergreens such as spruce, pine, and fir are excellent for windbreaks. They give year-round protection and are usually long-lived. Where they grow fairly fast and survivals are good, the entire windbreak might be evergreens.

Where evergreens grow more slowly or are hard to get started, broadleaf (deciduous) species such as elm, ash, and honeysuckle, may be used along with the evergreens to get protection at the earliest possible date. The broadleaf trees and shrubs are easier to start. They usually grow faster and give earlier protection, but will not live so long as the evergreens. In the meantime the evergreens will

grow and continue to give you windbreak protection after the broadleaf varieties fail or die out.

Where an evergreen row is planted next to a broadleaf row, make sure the broadleafs do not interfere with the growth of the evergreens. Use a slow-growing broadleaf variety next to the evergreen or leave additional space between the evergreen and broadleaf rows. At maturity the trees in one row should not overtop or suppress the ones in a neighboring row.

In some parts of the country the evergreen rows are preferred on the leeward side of the windbreak; in others they are planted on the windward side. The deciding factor should be the amount of limb and branch breakage expected from melting snowdrifts or the amount of sunlight that each species requires. It is best to follow the arrangement common in your community.

How to space

A good rule where soil moisture is adequate is to space the tree rows so the crowns will close in within 5 years. The trees will shade out weeds and thus reduce cultivation time. In areas of plentiful moisture, 8 to 10 feet between rows is best while in dry sections, up to 16 feet or more may be needed for best growth. Allow enough space between the rows to cultivate with available farm cultivators.

Where wide spacing is used, the windbreaks must be cultivated for the life of the planting to prevent weed competition for moisture. It is advisable to leave a strip at least a rod wide around the outside of the windbreak and keep it in clean cultivation.

Regardless of the spacing between rows, space the plants close together within the row. You need a tight barrier to make a good windbreak. Most windbreaks should have from 500 to 700 seedlings per acre. Spacing distances vary in different parts of the country. Here is a general guide for spacing within the row:

	Feet
Shrubs	2 to 3
Broadleaf trees of medium height	6
Tall broadleaf (deciduous) trees	8 to 10
Evergreens (conifers)	6 to 8

In those parts of the country where rainfall is favorable or where ample irrigation water is available, the tall trees and evergreens may be spaced a bit wider in the row than is shown above. Also the wider spacing should be used where summer moisture is deficient, as in the southern Plains.

NEB—1846

A 3-row evergreen and broadleaf tree windbreak in Nebraska. This wind barrier does not take up much land.

IA—862

A 50-year-old Iowa windbreak of pine and redcedar. It is dense from the ground to the top.

How wide to make them

There is no hard-and-fast rule on the width of field windbreaks. Make them wide enough to give the protection you need—from one to three or more rows wide but no wider than necessary. The number will be decided by several things.

Your soils will limit the species of trees and shrubs you can grow and their density of growth.

The kind of protection you need will determine the number of rows and the density of the planting. If you want maximum protection at ground level, plant shrubs or dense-growing evergreens; if you wish to protect large cultivated fields with the fewest windbreaks, use tall trees and shrubs or evergreens (conifers); if you want more wildlife, plant shrubs and evergreens most favorable to wildlife; and, finally, if you only want windbreaks to trap snow, 1- or 2-row plantings of dense low-branching species may do the job.

If evergreens are used, the number of rows can be fewer.

In irrigated areas and also where rainfall is

favorable, a 1- or 2-row planting may be adequate for field windbreaks. On the other hand, where tree growing is more difficult, such as in the Plains, a 3- to 5-row planting is often preferred. But, even here, 1- and 2-row windbreaks can be used in a windbreak system where soils and rainfall are favorable and other conservation practices are used.

Windbreaks for commercial orchards, truck gardens, and specialty crops are usually a 1-row type, especially in the irrigated valleys of Idaho and Utah, the Columbia Basin in Washington, and in southern California and Arizona.

Your windbreak should be tailored to fit your land and your needs, just as other conservation practices are. The important thing to consider in a field-windbreak system is to have enough tree barriers crisscrossing your fields to give the needed protection.

Field windbreaks do not generally need to reduce wind currents to the same degree as do farmstead windbreaks. They can be narrower and less dense. Part of the wind currents can blow through and still not damage crops or start soil blowing.

In snow country it is desirable to have a large part of the snowdrifts blow through the windbreaks onto the fields. Windbreaks for farmsteads, livestock, and wildlife, however, need to be wider and denser than field windbreaks. They should be wide enough to hold most of the snow and to reduce wind currents to a minimum.

How to prepare the land

It is always best to lay out your windbreak before you prepare the land, making certain that it has the right width and length, and that it is located properly.

After you have decided where to place your windbreaks, prepare the land well ahead of planting. In farming areas where summer fallowing is practiced, the windbreak plots should be fallowed at least 1 year. And it is often wise to fallow them in those areas where fallowing is not ordinarily done. Fallowing stores up moisture and helps to control weed growth in later years. If you have the equipment to do the job, fallow so that the stubble is left on the surface. Soddy land should be broken, worked thoroughly, and fallowed 1 or 2 years.

Where rainfall is adequate and in irrigated areas, deep fall plowing is best on loam or silt soils.

If your land is infested with grass or perennial weeds, kill them out before planting the trees. Do this with fallowing or by growing a row crop the year before you plant the windbreak. Good land preparation pays big dividends in increased tree growth and you will have fewer weeds.

It is best to leave some grain stubble or plant a cover crop on cultivated soils that are apt to blow. On these soils, do not fall plow. Several weeks before tree-planting time, plow out narrow strips wide enough for the tree rows. This gives the soil time to settle a bit. The same applies to sandy grassland where it is not safe to plow up the whole area. Where listing is common, some farmers prefer to plant their seedlings in lister rows.

Where moisture is short or where the soil is apt to blow, you can plant strips of tall-growing plants, such as 1 or 2 rows of corn, sorghum, or millet.

ND—777

A 3-row broadleaf windbreak in winter. Even with the leaves off, it reduces wind appreciably and traps snow for crop use.

Strips of sorghum planted between rows of young tree seedlings to protect them from hot, drying winds in South Dakota. In areas where snow is common, these strips also catch snow and add moisture.

Plant these strips at 15- to 20-foot intervals on the windbreak plot the year before you plant the trees and keep them cultivated. These strips protect the soil from blowing and catch snow during winter, thus adding moisture for the tree seedlings.

Leave the plant stalks through the spring months to reduce sand blasting—and to give some protection to the newly planted seedlings from hot, drying winds.

You can replant these corn or sorghum strips for 1 or 2 more years to protect the trees if you have a straddle-type cultivator or an implement that will handle such an arrangement. At this stage the cover crop should not compete with the small tree seedlings for moisture.

Choosing the seedlings

It is best to get seedlings grown in a nursery in your area or from one having a similar climate. There usually are State or private nurseries in your own State that grow the best kinds of seedlings. Your county agent, State Forester, or soil conservationist will help you contact a suitable one. Many farmers order extra seedlings with the first order to replace dead seedlings the next season.

Good quality, graded, vigorous seedlings are best. Though they may cost a trifle more, the extra cost is small as compared with the total cost of a windbreak.

Choose the size carefully. Seedlings that are either too small or too large usually don't grow well.

KANS—1762

Some nurseries sell potted evergreens. They survive better than bare-rooted plants. They can be planted with a shovel, plow, or a mechanical tree planter.

SD—544 ; SD—545

Many soil conservation districts own and operate mechanical tree planters: (Top) A "pull-type" machine that fastens onto the tractor drawbar. This is its 18th season. (Bottom) The machine is mounted directly on the tractor and is regulated hydraulically.

Seedlings of the broadleaf species should be 18 to 36 inches high. These are 1- or 2-year-old seedlings. They should measure about ¼ to ⅜ inch at the root collar. The root system should be well branched, from 8 to 9 inches long, and in balance with the stem. Larger seedlings cost more and ordinarily do not do as well as the 18- to 36-inch ones.

The best seedling size for evergreens is from 8 to 12 inches high, and they should have a well-balanced

NEB-1843 ; NEB-1844

(Left) A specially built plow for opening up a furrow for planting trees on sandy grassland. (Right) Pine trees planted in the furrow.

and fibrous root system. Get the grade and age recommended for your area.

Evergreen survival in dry, windy areas is often poor. Drying winds and hot temperatures kill or severely damage the stems before the root system can start working. Some nurseries offer potted evergreen plants at a reasonable cost. These plants insure much better survival since the shock of transplanting is less. The cost is higher as compared with bare-rooted seedlings, but it is usually worth it.

Planting the seedlings

When the seedlings arrive, open the nursery bales and check the order. Examine the plants for heating, molding, or dryness. If they are satisfactory, wet the roots, store them carefully in a cool place with roots protected, and plant within a few days.

If you cannot plant immediately, the seedlings should be stored outside. Dig a trench about a foot deep and bury the roots in soil, leaving the tops out.

Heeling-in bed.

This is called "heeling-in." Pack the soil firmly, water thoroughly, and make certain that no roots are exposed.

Evergreens (conifers) require extreme care. Do not expose the roots to the air for more than a few seconds. When heeling-in evergreens, the small bundles should be split and the seedlings spread out in the trench to insure that the root system of each seedling is protected by the soil.

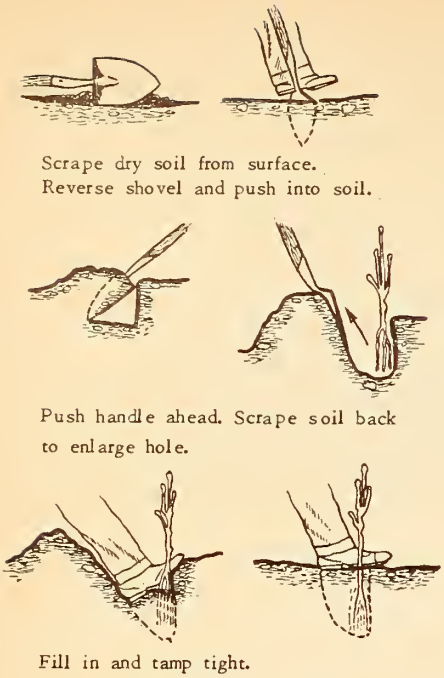
Plant the seedlings at the best time for your locality. In most of the North this will be during the spring months, but further south the dates may be earlier. It is best to get your seedlings at the time you plan to plant. After the seedlings arrive, plant them as soon as possible.

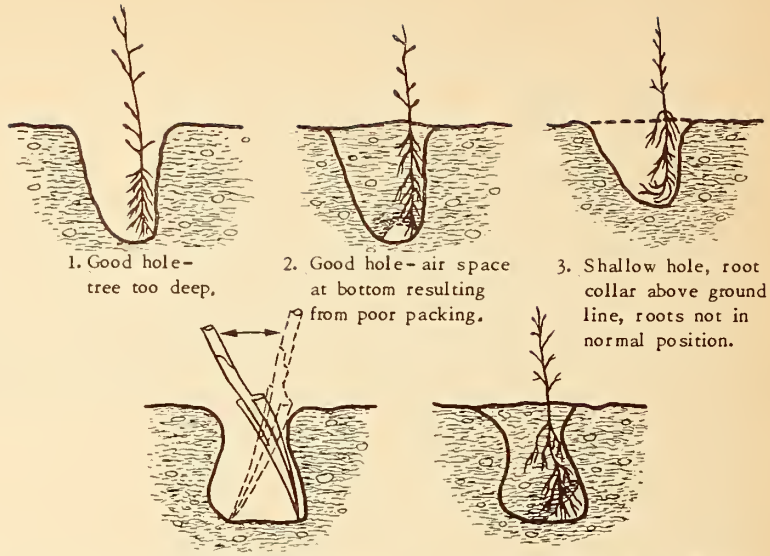
Many soil conservation districts and some State Foresters and State game departments provide mechanical tree planters. Trained planting crews are often available locally. Such crews can plant as many as a thousand seedlings an hour.

If you hand plant, stake out the rows according to your planting plan. Plant the trees in straight rows or on the contour to make cultivating easier.

A good planting job insures better survival. Avoid a hot, windy day. After the tree windbreak is planted, water the evergreens if the weather turns hot and windy. Shingles or burlap strips staked on the windward side to shade and protect the evergreens may increase survival.

Replace dead trees and shrubs the following year with the same species. It is necessary to have a good stand if you want an effective windbreak—a gap in your windbreak is like a hole in a fence.

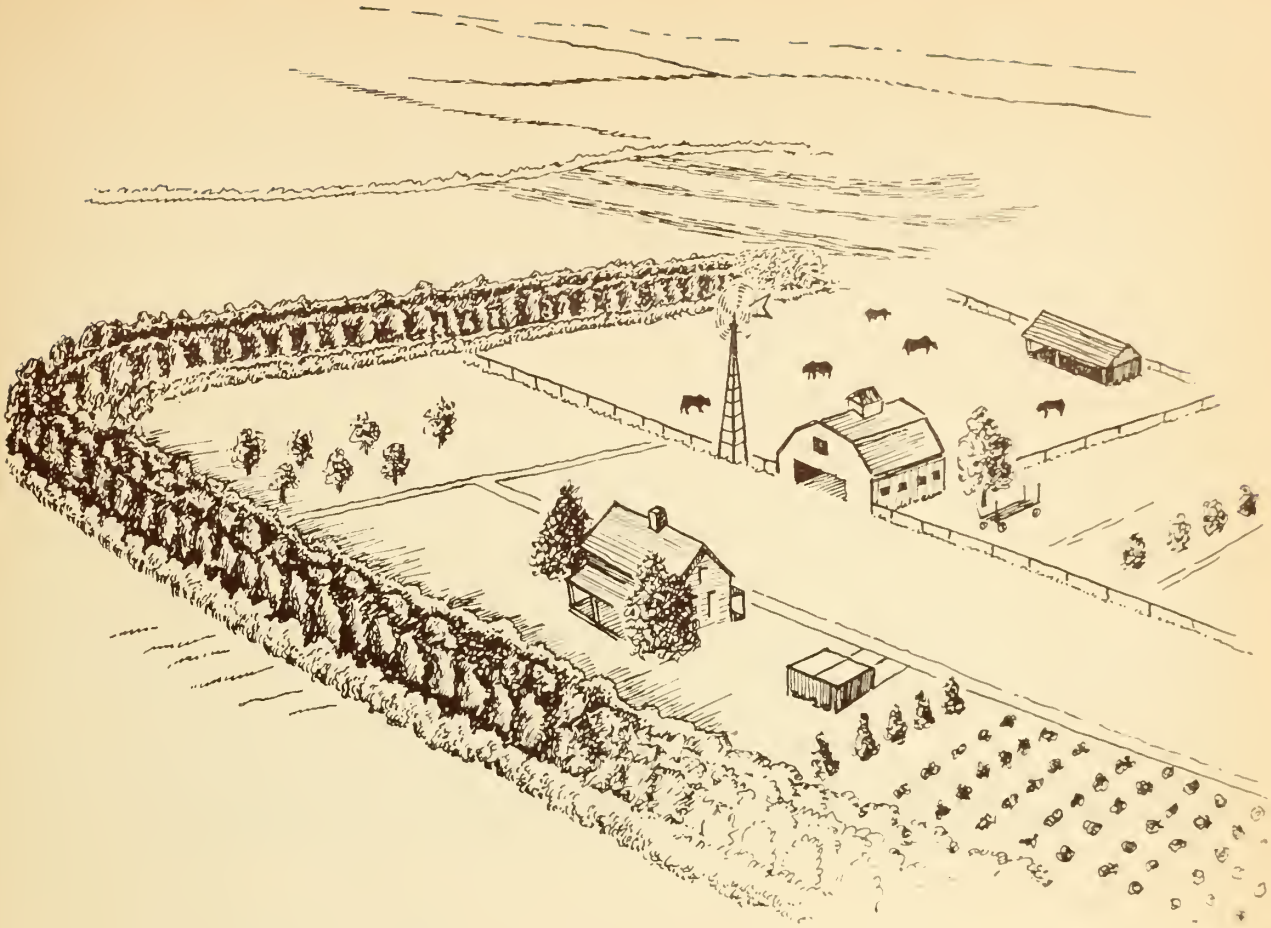




(Left) Planting with a shovel; (right) pointers on setting seedlings.

MONT-138

A well-planned Montana windbreak. The northwest corner is rounded for easier cultivation. Note trees on two sides of the farmstead and a narrow living snow fence to protect the roadway.



Typical farmstead windbreak.

Farmstead Windbreaks

A windbreak is especially useful around the farmstead. It means a lot when you are working outdoors around the yard, doing the chores, and tending livestock.

In the North the farmstead windbreak should have at least 7 rows to give wind protection and to trap most of the snow within it. Species used should give year-round protection, provide a barrier uniformly dense from the ground line to the top, and have a reasonably long life span.

In the South where snowdrifting is no problem, a few rows may be all that is necessary for the farmstead windbreak. Evergreens (conifers) are always preferred for winter protection. If summer protection is desired from the south, a few rows of broadleaf (deciduous) trees to screen the hot winds will be ample. A too-dense windbreak may cause air stagnation and increase temperatures in the farmyard.

How to plan them

The location and layout of your farmstead windbreak should be considered with care, or it may become a hazard rather than a benefit.

Where snowdrifting or soil blowing is a big problem, give a lot of thought to placing your farmstead windbreak plantings in relation to your buildings, yard, and driveways. Your windbreak is a longtime proposition—it will pay you to lay it out right in the beginning. Many farmers change fences, driveways, and feedlots before planting to get the most advantage from the windbreak shelter.

Your farm may be so close to the road that you do not have room for a good windbreak. Or you may have room for only a few rows. If so, consider planting on the other side of the road. In the North, however, make sure you plant back far enough so that snowdrifts do not block the road. Leave room for a windbreak when establishing a new farmstead.

IDA-45,033

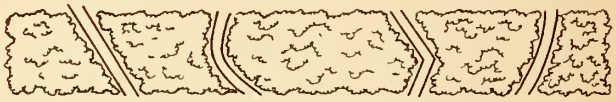
This windbreak protects an Idaho ranch headquarters.

You get the most protection from your windbreak by locating it against the prevailing winds, and it should protect 2 or 3 sides of your farmstead. Make the planting long enough to protect all of your farmstead and feedlots—extend it at both ends at least 100 feet beyond the area to be protected.

Wind and snow whip around the ends of the windbreak so be sure to allow for this.

Lanes or roads through the planting may reduce its usefulness. But this can be prevented by running such lanes at an angle.

If snowdrifting is a problem leave space between the windbreak and the main buildings, preferably from 100 to 150 feet. At this distance you will get adequate protection from winds, and you should not be troubled with snow in the yard. But do not place the windbreak too far from the farmstead or you will lose wind protection. If possible, this should not be over 300 feet. If your land is sloping, plant on the contour, if practicable. In low-rainfall areas divert water into the windbreak from an adjoining field or road ditch. Avoid planting on old straw-pile bottoms and manure piles. Seedlings do not grow well on such spots.



Roadways through windbreaks should be at an angle or curved.

If you have an old windbreak or one that is too open at the bottom, you may improve it by planting another 3 to 5 rows of trees and shrubs to the windward side. Or you may want to plant a whole new windbreak—either to the windward or leeward, depending on space. When the new windbreak grows up, you can remove the old one or leave it for additional wildlife cover.

For information on spacing, kinds of trees and shrubs to plant, planting, and other details, see Field Windbreaks, page 9.

Managing the Windbreaks

Even where trees grow naturally and where forests once grew, such as in the Northeast, or the South, your windbreaks should receive some care

right after planting. And after they are well started, keep out fire, insects, and livestock. Spot or row failures should be replanted. Later they may require thinning.

On grassland soils, such as in the Plains, nature does not favor trees. Here it is necessary to tend them like you do field crops. They must be cultivated, weeds and grasses should be kept out, insect outbreaks controlled, and all available water conserved or diverted to their use. Here, too, row or spot failures must be replanted. Later it may be necessary to plant additional shrub or evergreen rows to maintain density. Groups of trees change in character as time passes. Some species thicken up, others thin out, while still others may lose only their lower branches. It may be necessary to thin some rows to keep the number of trees in balance with the available moisture. Some cutting and pruning may be needed to keep an adjacent broadleaf row from damaging evergreens. In windbreaks overrun with weeds and grasses, their vigor and usefulness may be restored by removing partial row failures, destroying the grass and weeds, and replanting parts of the windbreak. For the best growth and life span, the windbreak trees need to be favored by the best care you can give them.

WYO-418

Sheep have grazed these Russian-olive trees in Wyoming, thus causing a browse line. Livestock in windbreaks ruin or kill the trees and shrubs.

Protecting from livestock

Livestock must be kept out of your windbreaks. This is true regardless of the age of the trees. Livestock browse the leaves, break off branches, compact the soil, and open up the lower parts of the windbreak. Weeds and grasses creep in and the

A 5-row additional planting of trees and shrubs to the outside of this old North Dakota grove makes it a better windbreak It will trap the snow and keep the wind from blowing into the farmyard. The old trees are too open at the bottom

NEB-1845

Three rows of redcedar planted on the windward side of older American elm in Nebraska. They will trap snow in the trees and increase the windbreak density. As trees grow older their shape and density may change.

ND-565

A new North Dakota windbreak with a good fence. It is important to leave enough room between the fence and the trees for longtime cultivation.

windbreak becomes less effective for stopping wind and snow. Outside of fire, there is no surer way for ruining a windbreak.

When the windbreak is young, poultry should also be kept out since they eat the tender buds.

If you need a fence to keep livestock out, do not crowd it in too close to the planting. Allow ample feeding space for the tree roots and room for cultivating. A cultivated strip next to the windbreak serves as a firebreak, keeps grass and weeds from creeping into the windbreak, and lets the soil take in rainfall.

Cultivating

No single management factor is more important in growing windbreaks than good clean cultivation. Letting weeds and grass compete for limited moisture and plant nutrients may result in a poor windbreak or a complete failure. Even where there is plenty of moisture, trees do better with timely cultivation.

Ordinary farm equipment can be used to keep your windbreak clean. A 1- or 2-row cultivator is ideal to straddle the rows the first year. A sweep-type or spring-tooth cultivator or a tandem disk does a good job between rows.

As your planting grows older, use narrower equipment. It is best to cultivate shallow—3 to 4 inches is deep enough. You may damage the roots if you cultivate deeper.

Cultivate for as many years as you can. In dry areas, or on unfavorable soils, this may mean for the life of the windbreak. Keep the outside strip next to the windbreak clean—it will make the trees grow faster and increase their life span.

Cultivate at least 3 to 4 times a year and get the weeds when they are small. It is important to hand-hoe the weeds the cultivator misses. Tractor-mounted tree cultivators will kill most of the weeds and make weed control easy and simple.

In the North cultivate the last time during late summer. If you cultivate too late in the season, the trees may not harden off. Then they could be injured by an early freeze. If the windbreak area is apt to blow in the winter, plant a cover crop between the tree rows early enough to make fair growth before winter. In snow country, this helps to trap snow for more moisture.

Many new chemicals are under test for weed control. In the future these may reduce the need for cultivation.

Mulching

Mulching with hay or straw in place of cultivation is unsatisfactory under dryland farming conditions.

NEB-1549

A clean windbreak is necessary. It leaves all the moisture for the trees.

SD-540

A mechanical tree cultivator.

Where rainfall is good and in irrigated areas, mulching with seed-free straw, stalks, or cobs may be satisfactory after the windbreak is at least 5 years old. But cultivation is still the best way to keep weeds and grass under control.

Where soil washing is a problem in the windbreak, spread a light mulch once a year as long as it is needed. If it is a bad problem, consult your local soil conservationist.

Pruning

Hold pruning to a minimum. Cutting off the lower branches makes a poor barrier against snow and wind. Prune only branches that have been damaged enough to kill them. The tall-tree species usually grow single-stemmed. If they become damaged, a number of stems may develop. Select and leave the tallest and straightest stem and prune out the rest.

Irrigating

Irrigate windbreaks much the same as you do deep-rooted farm crops. A good soaking is better than several light irrigations. In the North, stop watering about a month before the first frost to give the trees a chance to harden off before the first freeze. If irrigation water is available after the leaves drop, give the windbreak a soaking just before the winter freeze-up. This is especially helpful to evergreens.

Protecting from fire, rodents, and sprays

For protection against fire in the windbreak, keep the strip around the windbreak free of weeds and grass. Sprays like 2,4-D will kill trees and shrubs. Do not use them in or near the windbreak.

Rabbits and mice often damage young windbreaks, especially during the winter months. Several good rabbit repellents and mouse poisons are available from seed houses and nursery stores. Reduce rodent damage by keeping out weeds and grass.

For detailed information, see your county agent, the State Forester, a wildlife specialist, or the Soil Conservation Service technician in your local soil conservation district.

Thinning

When the larger trees in your windbreak reach 5 to 6 inches in diameter, they may need thinning. Do not thin the shrubs. Since the minimum space

Cedar reproduction is good in this 20-year-old Nebraska windbreak. Some of the broadleaf species are thinning out and young seedlings will replace them.

Cotton growing up close to a windbreak in west Texas. A crop of guar was turned under green the previous season. Little sapping is noted.

78,303

In the southern Plains an early maturing crop, such as the Abruzzi rye shown here, may be planted next to windbreaks to reduce crop losses from sapping. Some grasses do fairly well also. Root pruning will help.

MINN-1632

Sapping is not a serious problem where snowdrifts add moisture. Crops are good right up to the tree barrier on this Minnesota farm.

a tree needs to stay vigorous is dependent on rainfall, snow, soil, and other factors it is advisable to get advice from a specialist before thinning.

Sapping and shading

Tree windbreaks need moisture to live. Tree roots sometimes reach out into the field in dry seasons and sap moisture from the crops planted next to them. This problem is most common in the southern Plains.

Many farmers plant an early maturing grain crop next to their windbreaks to avoid this loss. The crop matures before the hot, dry months occur. Some grasses may also be used instead of grain.

Some farmers use the land next to the trees as a turnaround area or as a roadway or lane.

Root pruning with a ripper or chisel while the trees are dormant also helps. It is best not to do this when the soil is dry—the trees may be severely injured.

If the windbreaks make lots of shade, plant a crop that will stand some shade next to the trees.

Many of the older windbreaks have species especially bad for sapping—such as Osage-orange. Use those trees and shrubs that will sap the fields the least.

In areas where snowdrifts add moisture, sapping is not so serious. Even here it might be best to use the area next to the trees for a roadway or put it into an early maturing crop.

Where Is Help Available?

Before you plant a windbreak, get advice from local tree specialists. It is wise to have the windbreak sketched out on paper. Your Soil Conservation Service technician, the county agent, the farm forester, and, in some States, game department officials are available to help you plan and lay out your windbreak plantings. They can also tell you where you can get good-quality seedlings. The County Agricultural Stabilization Committee will tell you whether you can get financial help on a conservation cost-sharing basis. In many counties, soil conservation districts have mechanical tree planters to handle the tree-planting job at a reasonable cost.

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